

Codman Awards

Improving Pediatric Immunization Rates in a Safety-Net Delivery System

Paul Melinkovich, M.D.
Anne Hammer, B.S.N., R.N.
Amie Staudenmaier, M.Ed.
Michele Berg, M.B.A.

Denver Health and Hospital Authority is an integrated health delivery system with a 147-year history of serving patients in the City and County of Denver, Colorado. Its system components include a 500-bed public hospital, the 911 emergency response system, the local public health department, and a network of community and school-based health centers.

Denver Health and Hospital Authority established one of the first community health centers in the United States in 1966. The community health services network has 8 family health centers located in low-income communities of Denver and 12 school-based health centers located in Denver's public high schools and middle schools. In addition, a variety of maternal and child case management and outreach programs compliment this network of primary care services. Denver Community Health Services (DCHS) provides more than 320,000 primary care visits per year and is the primary provider of care to the low-income population in Denver. More than 35% of Denver's children receive care through this primary care delivery system.

The Need to Increase Pediatric Immunization Rates

By 1993, several events that had occurred on a national and local level led to recognition of the issue of low pediatric immunization rates and ultimately the implementation of an immunization initiative:

- The 1989–1991 resurgence of measles in the United States
- The 1993 Federal Childhood Immunization Initiative
- Historically low childhood immunization rates in Colorado

Article-at-a-Glance

Background: Denver Community Health Services (DCHS)' goal was to increase childhood immunization rates in the high-risk pediatric patient population served through its safety-net delivery system. The specific goal of the initiative was to ensure that children younger than 3 years of age with at least one primary care visit received all recommended vaccines by 24 months of age.

Methods: An immunization registry was developed to accurately track patients, regular assessment of immunization levels were conducted with provision of clinic-specific feedback, and team-based quality improvement meetings were held. The computerized immunization registry assisted in implementing all the remaining improvement activities. For example, improvement of on-time delivery of vaccines in primary care clinics was accomplished through a rules engine in the vaccine registry, standing orders for vaccine delivery, and implementation of vaccine delivery protocols that eliminated missed opportunities.

Results: From 1995 to 2006, Denver Community Health documented a 47% increase in immunization rates for 2-year-old patients and a 26% increase for 1-year-old-patients. Two-year-old immunization rates exceeded 85% by the end of this time period.

Discussion: The initiative improved pediatric immunization rates with demonstrated sustainability during a 10-year period. Success is attributed to staff commitment to process improvement activities and use of a patient registry for pediatric immunization delivery.

Initial assessments in childhood immunization rates conducted in 1993 by chart audit were quite low. Because these rates put the community at risk for further outbreaks of vaccine-preventable diseases, the pediatric immunization initiative, which included multiple strategies known to improve pediatric immunization rates, was developed.

The initiative, which was spearheaded by the associate medical director of community health [P.M.], was designed to increase childhood immunization rates in the high-risk pediatric patient population served through the DCHS safety-net delivery system. The key methods chosen to improve vaccine rates were as follows:

- Accurately track patients
- Regularly assess immunization levels
- Improve the on-time delivery of vaccines in primary care clinics

The target population for the initiative was children younger than three years of age who had made a medical visit to one of the nine DCHS sites serving infants and young children. The initiative's specific goal was to ensure that these children received all recommended vaccines by 24 months of age.

Team members, drawn from a variety of departments within DHHA—the associate medical director for community health (team leader [P.M.]), a physician from the public health department (data expert), a community health immunization program manager [A.H.], a public health nurse program manager, a data applications analyst [M.B.], and a data entry clerk—planned and oversaw the initiative. Key stakeholders also included leadership from the inpatient hospital newborn nursery and from information services. In addition to providing leadership for the initiative, team members provided significant support during the initiative. The immunization program manager and data entry clerk served as immunization resources to the organization's clinical and clerical staff.

Physician team leaders, nurse program managers, and nurse immunization “champions” at each primary care clinic were responsible for implementing the immunization initiative at their respective sites. The registry data application analyst remains responsible for overseeing registry enhancements and querying the immunization registry on a quarterly basis to produce the immunization

assessments for each site. The quality improvement (QI) coordinator receives this data and creates and disseminates necessary reports to the clinical teams.

Methods

The key methods used to improve vaccine rates were to accurately track patients in need of vaccines, regularly assess immunization levels and provide clinic-specific feedback, and improve the on-time delivery of vaccines in all primary care clinics serving children. The process improvement activities, as described in Table 1 (page 207), implemented to achieve these objectives included development of a registry, quarterly immunization assessments, immunization protocol development, standing orders for childhood vaccines, and development and sharing of immunization “best practices.” The Centers for Disease Control and Prevention (CDC) National Immunization Program (NIP) has identified several strategies proven to lead to high immunization rates at the practice level. These strategies include ensuring accuracy and availability of the vaccine record, providing recommendations to parents of the need to return for additional vaccines, use of reminder and recall messages to parents when their child is in need of vaccines, prompts to providers that a patient needs a vaccine, reduction of missed opportunities to vaccinate a child at every visit, and reduction of barriers to immunization delivery within the practice.¹

IMMUNIZATION REGISTRY

The computerized immunization registry, implemented throughout the DCHS delivery system, was used to conduct the remaining improvement activities. In keeping with the CDC's recommendations, the registry has the ability to protect confidential information, enroll all children automatically at birth, give providers access to complete vaccination history, recommend needed vaccinations, notify children who are due or overdue for vaccinations, assess practice-level coverage, and produce authorized immunization records.²

Initially, chart audits were used to assess performance. Yet whereas they provide immunization rates on a sample of patients, a registry allows for assessment of performance on the entire patient population. In addition, the registry improved many aspects of data management and patient care, including the following:

Table 1. Improvement Activities*

Improvement Activity	Description, Purpose, Frequency	Team Members Involved
Develop immunization registry	Accurately track patients. Facilitate electronic queries and reports for entire patient population. Generate age and interval-based vaccine recommendations.	Team leader; data expert; IS nursing program managers
Immunization rate assessments	Quarterly CASA rate assessments for 1-year and 2-year old populations. Evaluate performance and set benchmarks. Comparison to other sites and to national and local rates.	Registry application analyst; team leader; immunization program R.N.
Immunization team QI meetings	Semiannual site-specific immunization team meetings to review rates, address barriers and develop a plan for performance improvement. Meetings facilitated by QI staff using the Plan-Do-Study-Act (PDSA) method.	QI coordinator, immunization program R.N.
Immunization Protocol Development	Evidence based protocol for vaccine delivery to identify appropriate spacing indications for childhood vaccines	Team leader, immunization program R.N.
Reminder/Recall activities	Monthly lists of children not up-to-date with immunizations generated for each site. Associated postcards are generated to send to parents.	Immunization program data entry clerk; site-based nurse leader; site-based nurse immunization "champion"
Standing orders	Patient-specific standing order for immunizations based on patient age, prior vaccine history, documented contraindications, and recommended childhood schedule. Promotes on-time vaccine delivery and no missed opportunities.	Registry application analyst, team leader, and immunization program R.N.
Staff education	Initial orientation to registry and immunization practices. Annual competency review. Ongoing education related to emerging vaccine issues and updates.	Registry data entry clerk and designated superusers; staff development department; immunization program R.N.
Sharing immunization "best practices"	Lessons learned at one site are transferable to other sites. Adherence to national and state practice recommendations.	Team leader, immunization program R.N.
Celebrating successes	Provide incentive to team members for performance improvement. Highlight process improvement accomplishments at site-based, agency, and regional levels.	Ambulatory care leadership, team leader; immunization program R.N.

* IS, information systems; CASA, Clinic Assessment Software Application; QI, quality improvement; R.N., registered nurse.

- Addition of any prior vaccination history to ensure accuracy of the record
- Inclusion of vaccines administered at all organizational sites to ensure completeness of the record
- Real-time data availability during the patient visit

IMMUNIZATION RATE ASSESSMENTS

The Clinic Assessment Software Application (CASA) developed by the CDC NIP is used to assess clinic-level performance. During the past 20 years, CASA has become the national standard for practice-based vaccination assessment. The CDC ensures that the system reflects changing Advisory Committee on Immunization Practices (ACIP) recommendations and user needs by continuously updating definitions, vaccine-specific age criteria, and diagnostic

capabilities.³ Data are downloaded from the registry into CASA to develop site-specific reports that can be used to pinpoint strengths and areas of improvement for individual practice sites. The clinic assignment for patients included in the reports is based on the site of the patient's last immunization visit.

Immunization records for all active patients in the target population are analyzed on a quarterly basis. On average, the vaccine history for a cohort of more than 3,000 1-year olds and an equal number of 2-year-olds are reviewed quarterly. The 1-year-old rate assessment evaluates the 3-2-2-2 series for a 12-23-month age cohort (3 diphtheria-tetanus-pertussis [DTaP], 2 inactivated poliomyelitis vaccine [IPV], 2 Hib [*Hemophilus influenzae*] vaccine, and 2 hepatitis B [HepB] vaccines by the time the child is 12 months of age).

The 2-year-old rate assessment evaluates the 4-3-1-3-3 series for the 24-35-month age cohort (4 DTaP, 3 IPV, 1 measles-mumps-rubella [MMR], 3 Hib, and 3 HepB vaccines by the time the child is 24 months of age).

After the data are downloaded, three types of reports are generated:

1. A complete site-specific CASA report for the 1st and 3rd quarters of the year includes a flow chart detailing children evaluated and their vaccination status with additional diagnostic data, including patients with late starts, missed opportunities for providing simultaneous immunizations, and a list of all children who are not up-to-date (UTD) including all missing immunizations.*

2. Quarterly ambulatory Microsystem Report Cards are used as a method to communicate current performance on all our operational and clinic quality improvement indicators.*

3. Quarterly updates of ongoing trend lines for each clinic display performance for the past two years. The trend lines display the percentage of children who are UTD with their recommended immunization series by clinic.

Most providers (public and private) overestimate the vaccination coverage level they are achieving with their clients. Assessment of practice-based coverage levels and feedback to providers has been an effective strategy for increasing vaccination of children served by a given practice.² Semi-annually, staff trained in the Plan-Do-Study-Act (PDSA) improvement approach attend staff meetings at each site to review the most recent immunization audit results. Improvement guides are generated with CASA reports to assist the immunization team in identifying improvement areas and to provide suggestions of how to enhance performance. With the assistance of QI staff, the interdisciplinary teams at each site develop plans for performance improvement.

REMINDER/RECALL ACTIVITIES

Patient recall lists are developed for each primary care site on a monthly basis for (1) all children from birth to 11 months of age who are at least one month behind on vaccine(s) and (2) children 12–23 months of age who are at least two months behind on vaccine(s). Postcards are

* The Clinic Assessment Software Application (CASA) Report and the Microsystem Report Card can be obtained by e-mail request to the author.

included with the lists for the clinic staff to use in patient recall activities. Staff at the primary care sites mail recall postcards to parents and use the lists to track outreach efforts to patients and remind them of needed vaccines. Patient status is changed to “moved” in the registry for parents who do not respond to a series of three recall activities during a period of at least two months and for patients with chart documentation that they have moved to another practice.

STANDING ORDERS

Clinical protocols, including immunization standing orders for nurses and other certified personnel to administer vaccines, were developed using the rules engine within the immunization registry. Education of all clinical staff was undertaken, with topics including the importance of the delivery of vaccines at every pediatric patient visit to reduce missed opportunities, the screening process for identifying appropriate contraindications to vaccine delivery, and the need to administer all indicated vaccines at a patient visit.

Results

Childhood immunization rates in the ambulatory network increased 26% in the 12–23-month-old patient cohort (from 66% in fall 1996 to 92% in fall 2006) and 47% in the 24–35-month-old cohort (from 38% in spring 1995 to 85% in fall 2006). Figure 1 (page 209) displays aggregate immunization rate increases with respect to time and interventions introduced. Increases are noted with each major performance improvement process, including assessment of CASA childhood immunization coverage rates with team feedback and QI meetings (initiated 1995; termed AFIX assessments in Figure 1), implementation of the registry (1995-1997), and initiating use of reminder/recall activities (1998). As teams plan and implement performance improvement at their sites, they retain the processes that are feasible and successful, usually leading to more gradual improvements.

The most compelling confirmation of sustainability was evident directly after an 18-month DTaP immunization shortage occurred. The rate for the 4-3-1-3-3 series decreased to 28% because of a mandatory suspension of the 4th dose of DTaP vaccine. Once the shortage was resolved, rates rebounded back to previous performance levels.

Percentage of Up-to-Date (UTD) Vaccinations for 12–23-month-old and 24–35-month-old cohorts, Denver Community Health (DCH), June 1995–September 2006

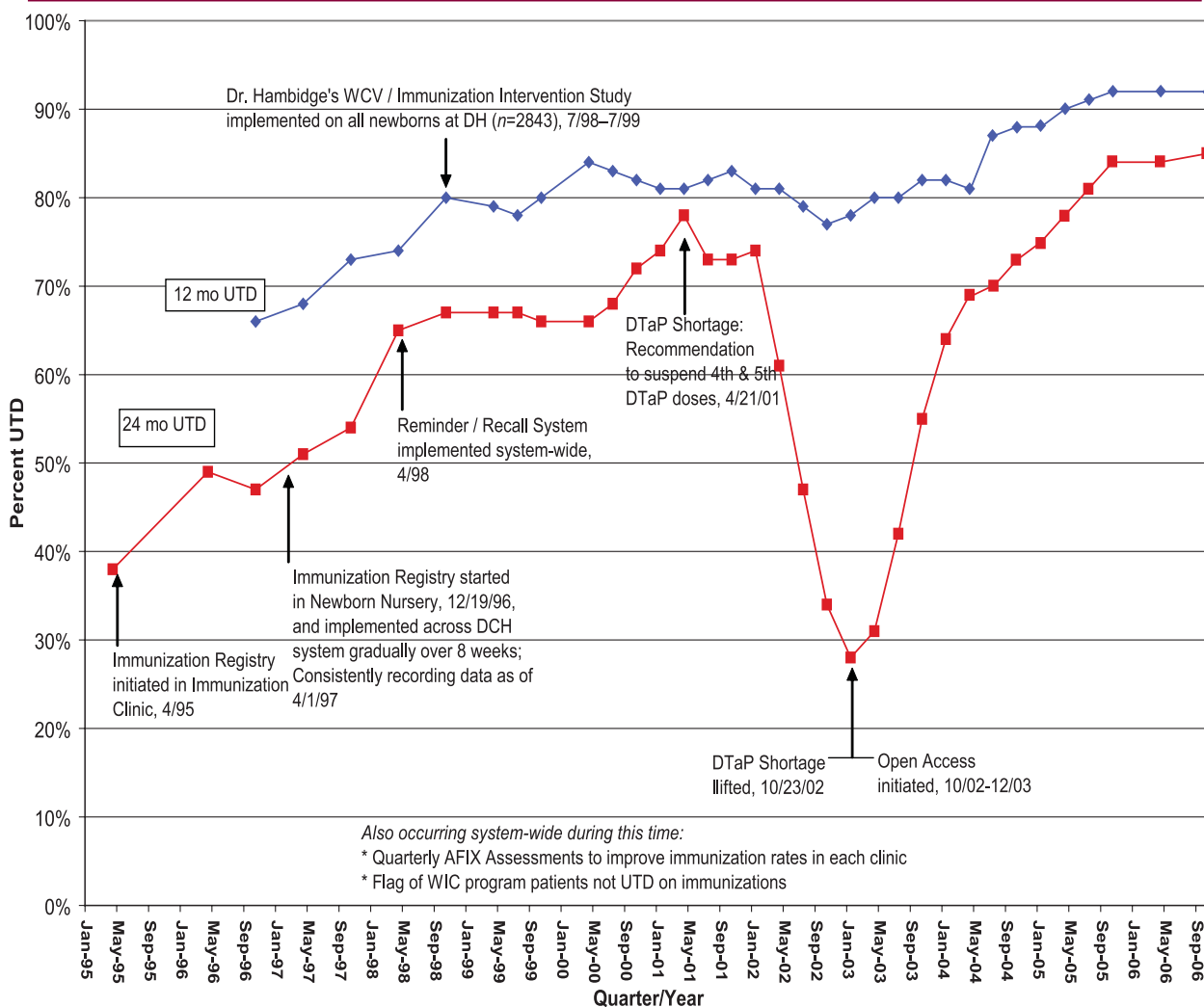


Figure 1. Childhood immunization rates in the ambulatory network increased 26% in the 12-23-month-old (12 mo UTD) cohort (from 66% in fall 1996 to 92% in fall 2006) and 47% in the 24-35-month-old (24 mo UTD) cohort (from 38% in spring 1995 to 85% in fall 2006). WCV, Well Child Visit; DH, Denver Health; DtaP, diphtheria-tetanus-pertussis; AFIX, Assessment and Feedback; WIC, Women, Infant, Children Nutrition Program.

Because the registry combines data from all Denver Health delivery sites, it continues to increase both in the number of patients and the number of vaccinations recorded. New patients are added to the registry with every patient registration in the DCHS, when a patient is seen in the public health department immunization clinic, and with every inpatient hospital admission, including the

newborn nursery. At every patient encounter, past vaccination history is added to the registry and necessary vaccinations are administered and documented.

Discussion

The key methods to improving vaccine rates in the DCHS primary care clinics were use of an electronic registry to

accurately track patients, regular assessment of immunization levels and provision of clinic-specific feedback, and improvement in the on-time delivery of vaccines. The obstacles that inevitably accompany any new project within a large organization were overcome by providing the clinics with feedback on their performance, educating staff on QI processes and immunization best practices, providing resources to help the teams identify areas in need of improvement, and helping support those system changes. At the beginning of the initiative, leaders spent time building team support to encourage a sense of ownership for its overall success. Teams have continued to maintain staff's commitment to increasing immunization rates by celebrating their successes in unique ways.

The development of a rules engine within the immunization registry, which, by generating standing orders, enables maximized use of support staff, has streamlined the process of vaccine delivery. The dissemination of site-specific data has encouraged friendly competition and increased team responsibility for performance improvement. Identifying process improvement projects using the PDSA model is replicable at other sites.

A registry to track and manage patient care can be used in the management of chronic disease as well as delivery of preventive services. With the success of the immunization registry at DCHS, patient registries for diabetes, cancer

prevention, pediatric asthma, and adolescent depression are now used to monitor performance and assist with patient tracking and recall. The performance improvement strategies used in the pediatric immunization initiative are slated to also be applied to immunization of adolescents and adults. **1**

Paul Melinkovich, M.D., is Director of Community Health Services, Denver Health and Hospital Authority, Denver; **Anne Hammer, B.S.N., R.N.**, is Nurse Manager, Immunization Program; **Amie Staudenmaier, M.Ed.**, is Program Evaluator; and **Michele Berg, M.B.A.**, is Data Systems Analyst. Please address correspondence to Paul Melinkovich, Paul.Melinkovich@dhha.org.

References

1. Centers for Disease Control and Prevention: Atkinson W., et al. (eds.): *Epidemiology and Prevention of Vaccine-Preventable Diseases* 8th ed. Washington D.C.: Public Health Foundation, 2005.
2. U.S. Department of Health and Human Services, Office of Disease Prevention and Health Promotion: *Healthy People 2010*. <http://www.health.gov/healthypeople/> (last accessed Feb. 12, 2006).
3. Centers for Disease Control and Prevention. *How to Read a CASA Summary Report*. http://www.cdc.gov/nip/publications/pink/appendices/B/casa_sum_rpt.pdf (last accessed Feb. 12, 2006).